FIG. 1

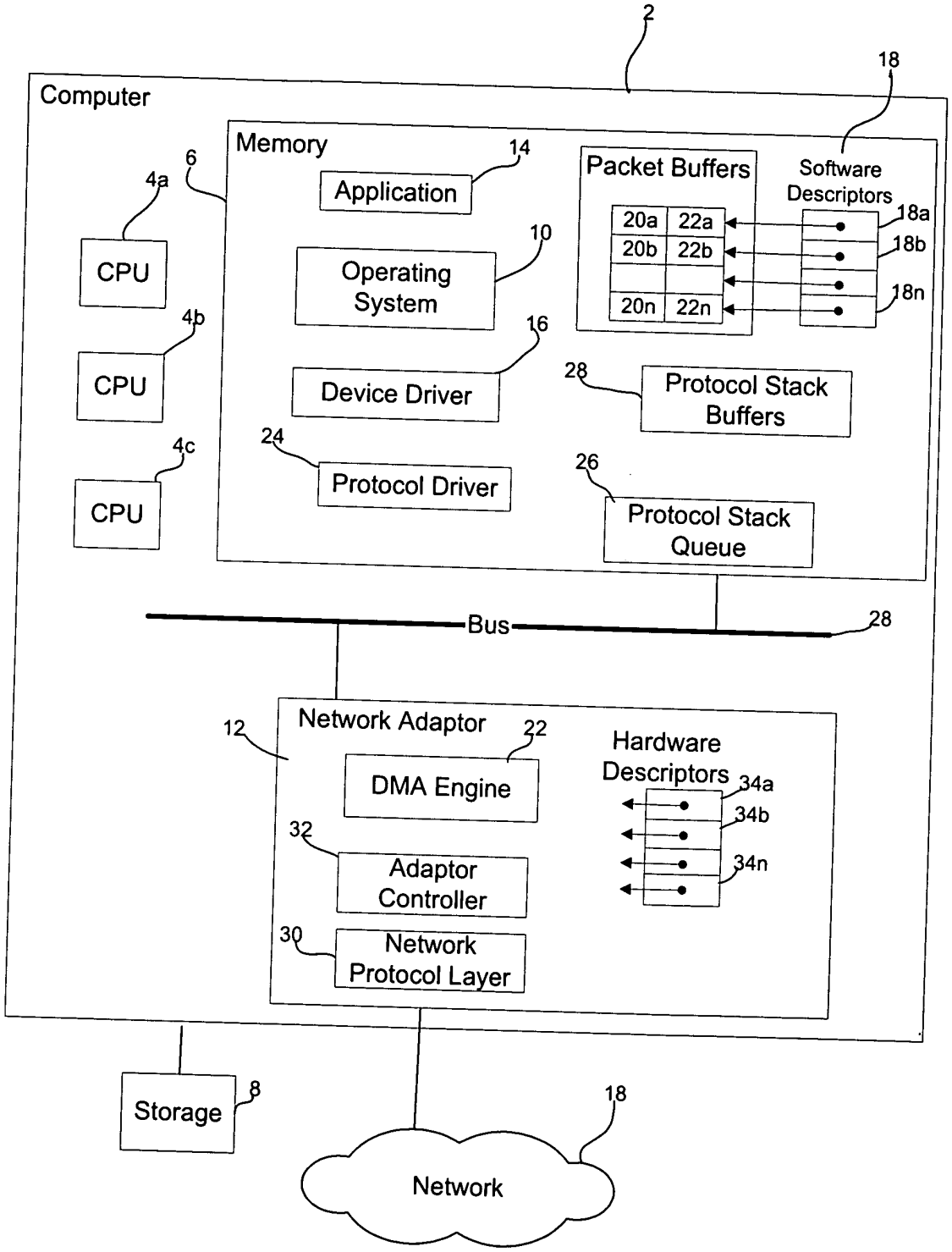

2
18
Computer
Memory
6
14
Application
Packet Buffers
Software Descriptors
4a
CPU
10
Operating System
20a
22a
18a
20b
22b
18b
18n
20n
22n
4b
CPU
16
Device Driver
28
Protocol Stack Buffers
24
Protocol Driver
4c
CPU
26
Protocol Stack Queue
Bus
28
12
Network Adaptor
22
DMA Engine
Hardware Descriptors
34a
34b
34n
32
Adaptor Controller
30
Network Protocol Layer
Storage
8
18
Network

FIG. 2

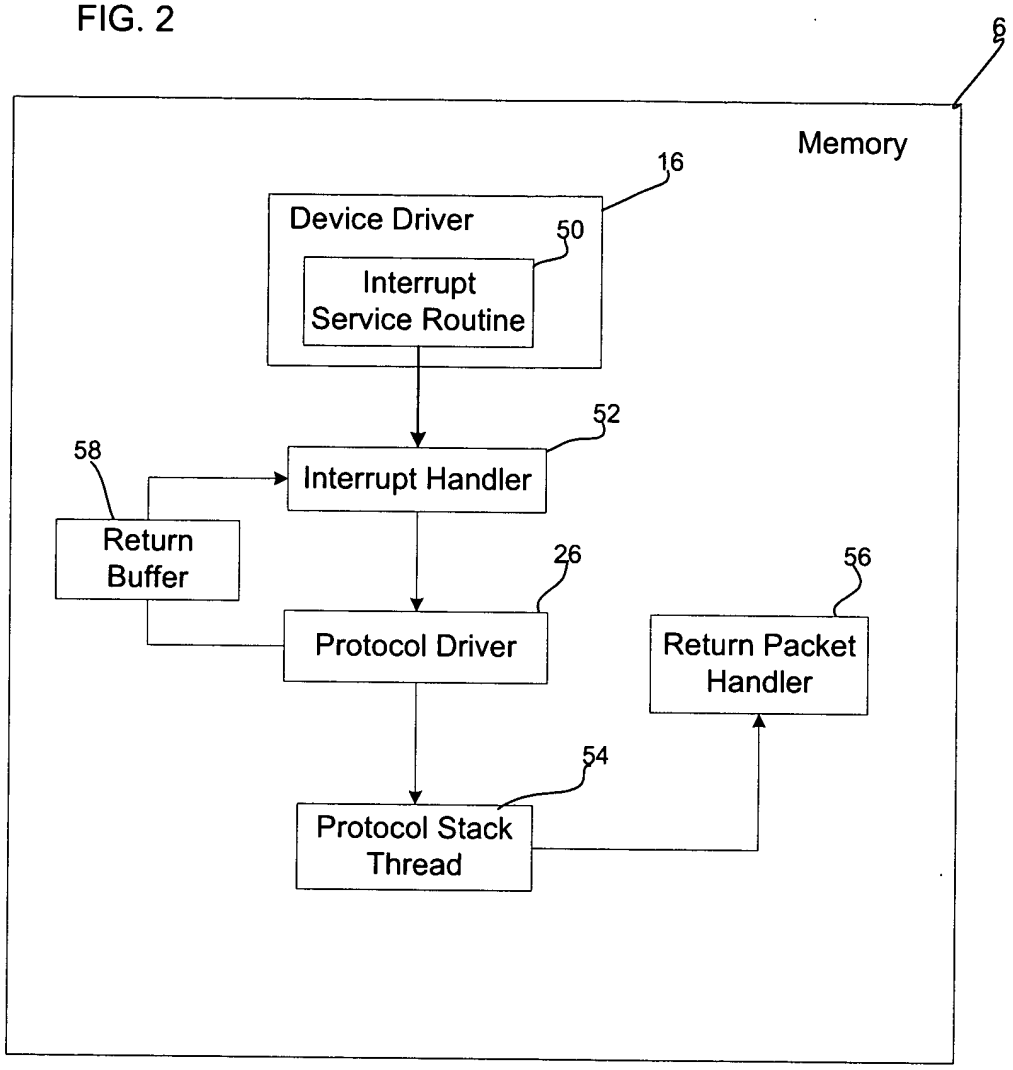
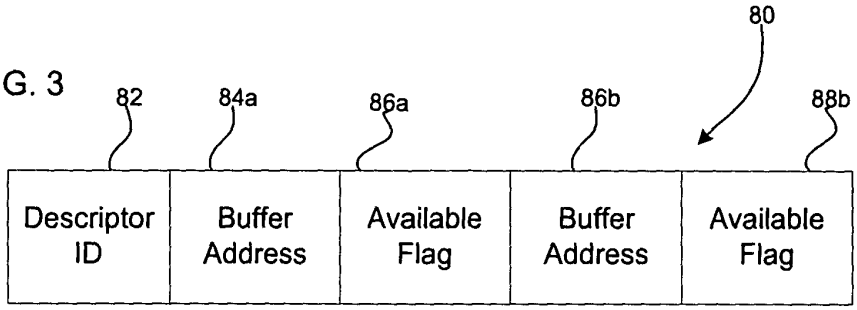
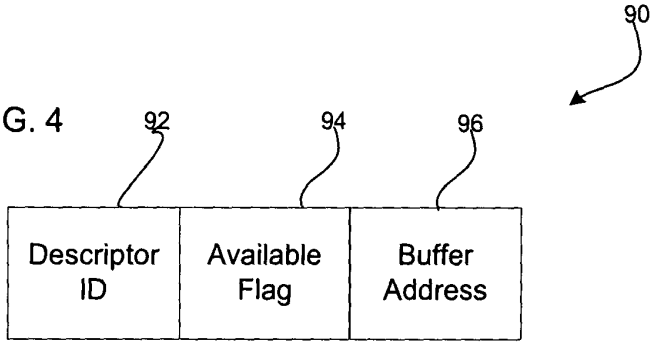

6
Memory
16
Device Driver
50
Interrupt Service Routine
52
58
Interrupt Handler
Return Buffer
26
56
Protocol Driver
Return Packet Handler
54
Protocol Stack Thread

FIG. 3



Software Descriptor Element

FIG. 4



Hardware Descriptor Element

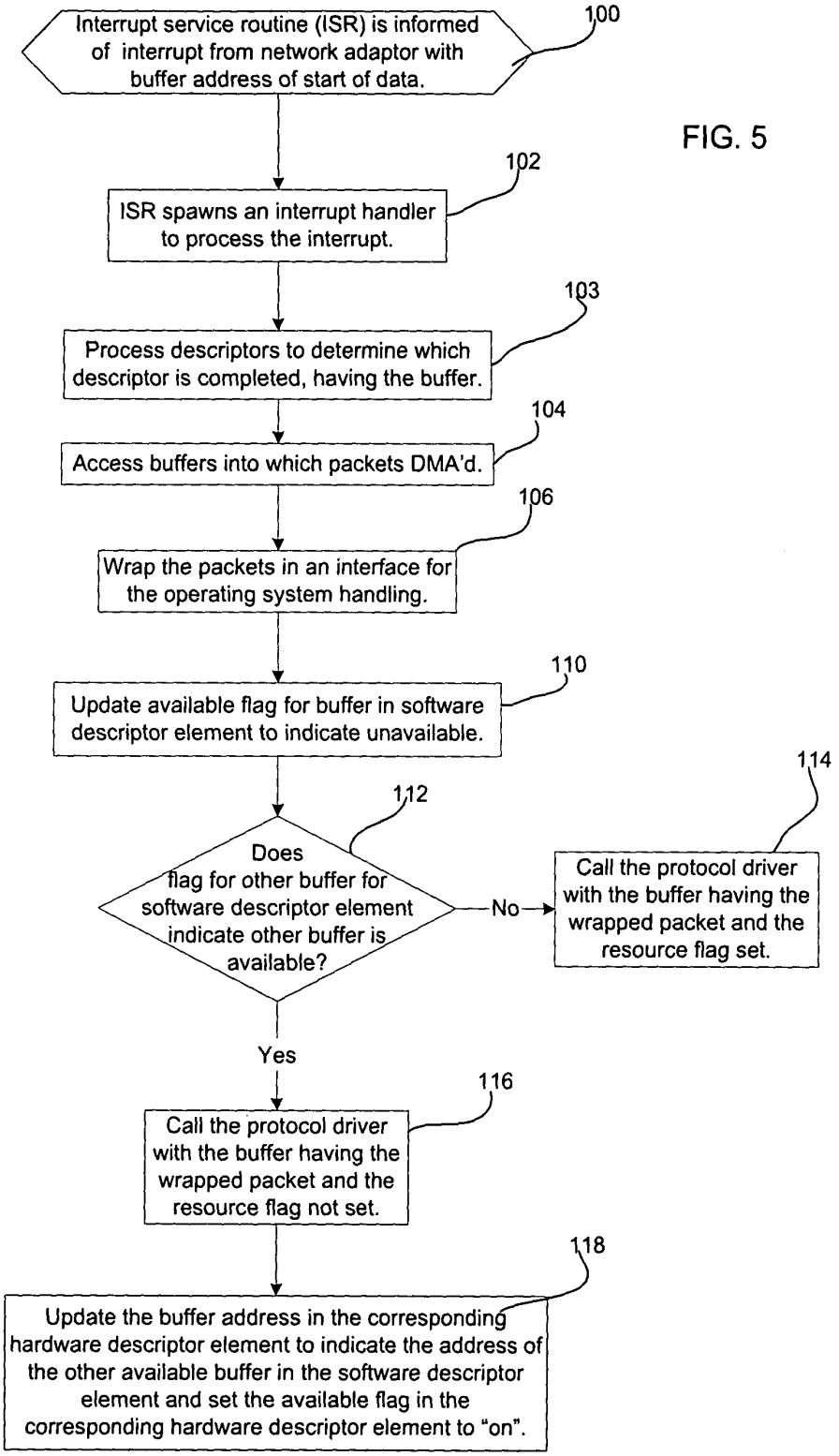

Interrupt service routine (ISR) is informed of interrupt from network adaptor with buffer address of start of data.
100
ISR spawns an interrupt handler to process the interrupt.
102
Process descriptors to determine which descriptor is completed, having the buffer.
103
Access buffers into which packets DMA'd.
104
Wrap the packets in an interface for the operating system handling.
106
Update available flag for buffer in software descriptor element to indicate unavailable.
110
Does flag for other buffer for software descriptor element indicate other buffer is available?
112
No
Call the protocol driver with the buffer having the wrapped packet and the resource flag set.
114
Yes
Call the protocol driver with the buffer having the wrapped packet and the resource flag not set.
116
Update the buffer address in the corresponding hardware descriptor element to indicate the address of the other available buffer in the software descriptor element and set the available flag in the corresponding hardware descriptor element to "on".
118

FIG. 5

FIG. 6

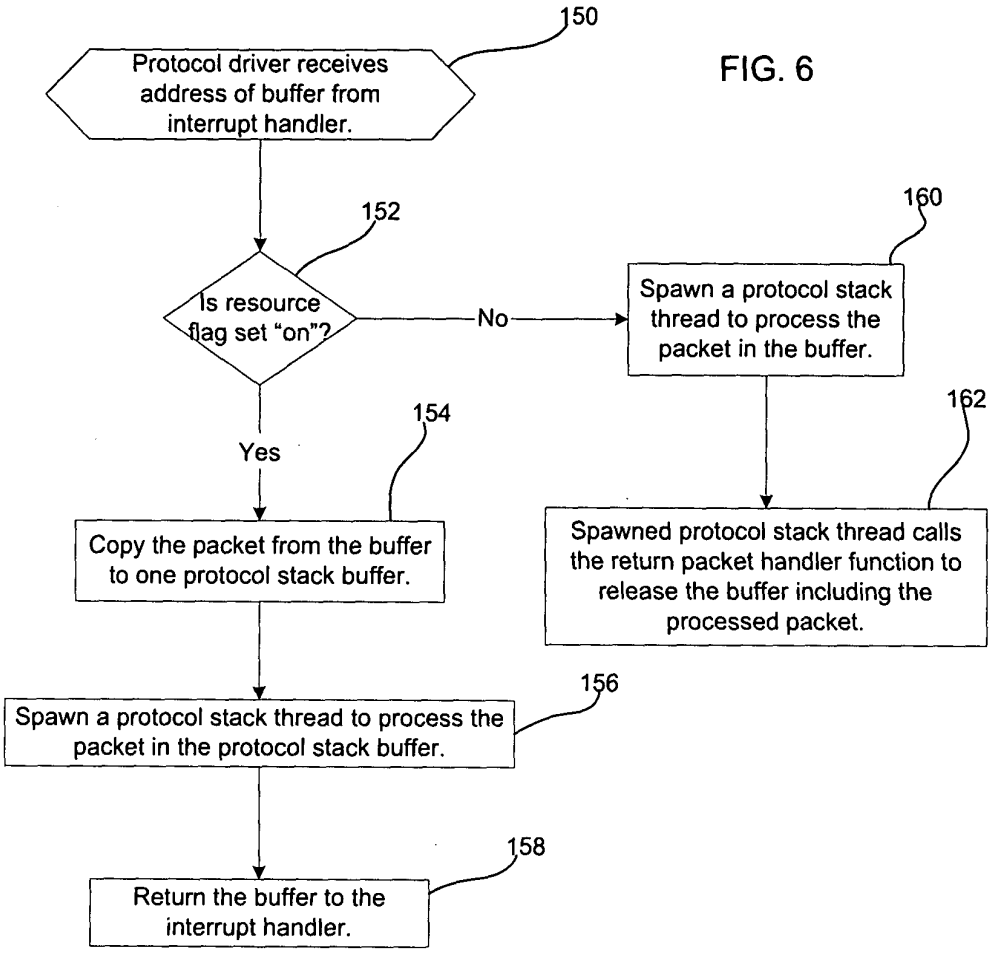

150
Protocol driver receives address of buffer from interrupt handler.
152
Is resource flag set "on"?
No
160
Spawn a protocol stack thread to process the packet in the buffer.
Yes
154
Copy the packet from the buffer to one protocol stack buffer.
162
Spawned protocol stack thread calls the return packet handler function to release the buffer including the processed packet.
156
Spawn a protocol stack thread to process the packet in the protocol stack buffer.
158
Return the buffer to the interrupt handler.

FIG. 7

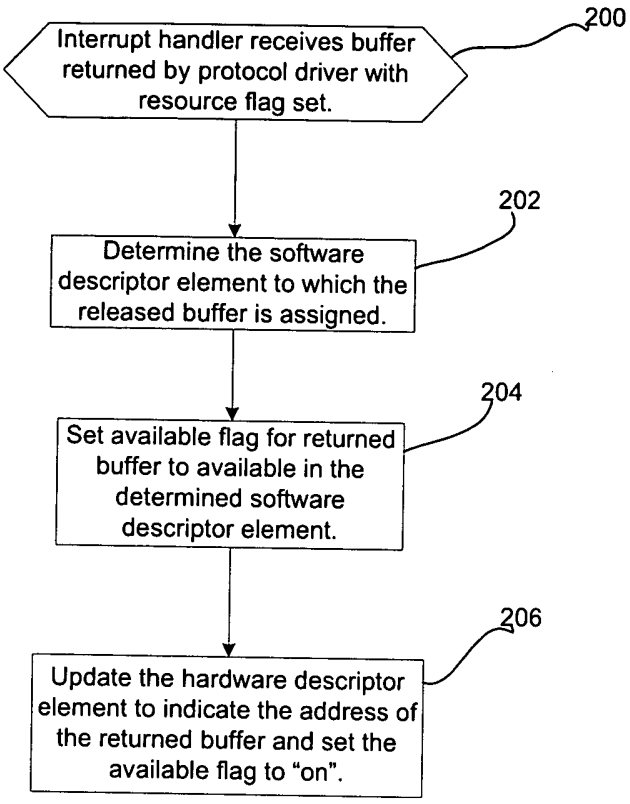

Interrupt handler receives buffer returned by protocol driver with resource flag set.
200
Determine the software descriptor element to which the released buffer is assigned.
202
Set available flag for returned buffer to available in the determined software descriptor element.
204
Update the hardware descriptor element to indicate the address of the returned buffer and set the available flag to "on".
206

FIG. 8

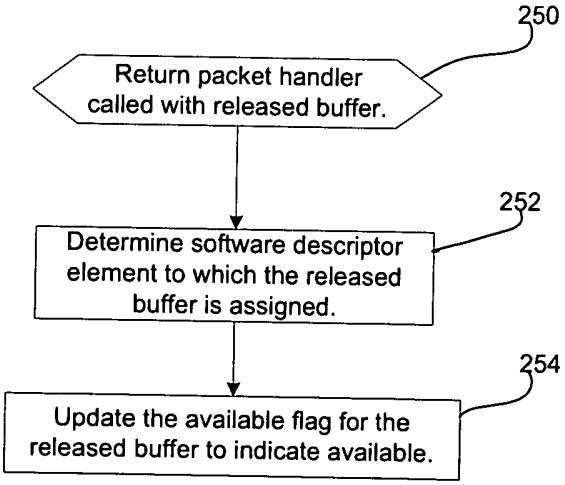
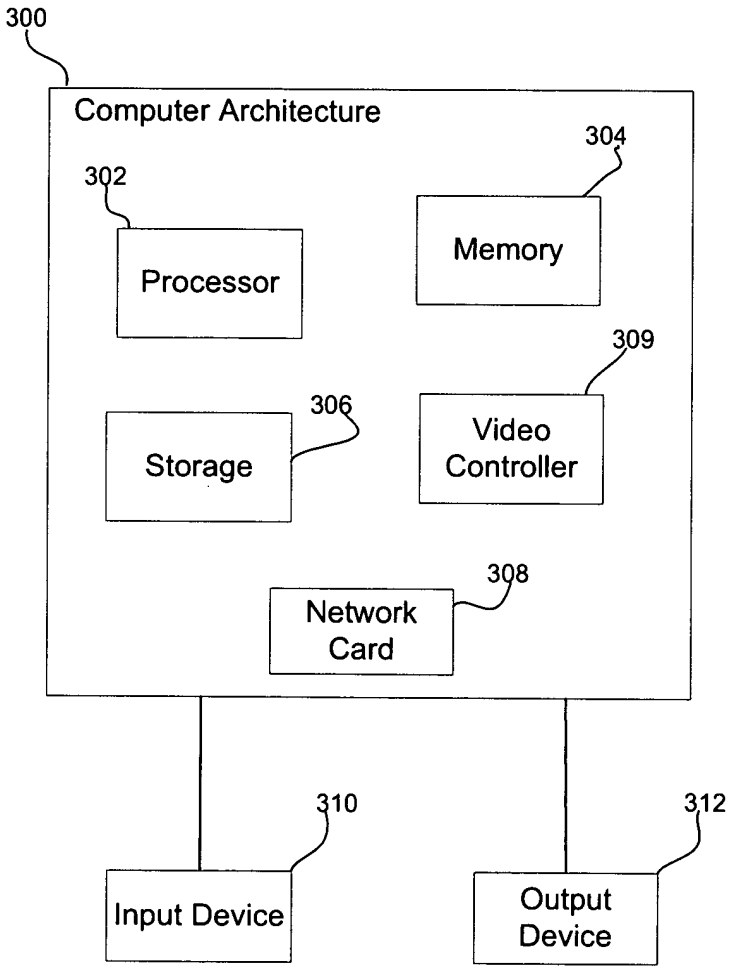

Return packet handler called with released buffer.
250
Determine software descriptor element to which the released buffer is assigned.
252
Update the available flag for the released buffer to indicate available.
254

FIG. 9


300
Computer Architecture
302
Processor
304
Memory
309
Video Controller
306
Storage
308
Network Card
310
Input Device
312
Output Device